UNITED STATES PATENT APPLICATION

OF

Vyacheslav S. Belenko and Vsevolod M. Kuzmich

For

WATERMARK-BASED COPY MANAGEMENT SYSTEM AND METHOD FOR DIGITAL MEDIA COPY PROTECTION

CROSS-REFERECNE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 60/269,846, filed on February 21, 2001, in the name of inventors Vyacheslav S. Belenko and Vsevolod M. Kuzmich, titled "Watermark-Based Copy Management System for Digital Media Copy Protection", which is hereby incorporated by reference as if fully set forth herein.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to media copy protection, and more particularly, to digital media copy management method and system that control each copy generation process and prevent any unauthorized (illegal) digital media data copy.

Discussion of the Related Art

[0003] Watermarking is a technology, in which copyright information (information indicating a copy guard) is expressed by a watermark superposed in media data. Such information is embedded into various media data including image data and sound data, and it should be invisible and inaudible to a human observer. The purpose of superposing a watermark in the media

data is to provide a proof of a copyright so that an illegal use and copy of the media data can be prevented. Therefore, the copyright information should stay stable in a host signal even when the host signal is subjected to any data process.

[0004] The technique for superposing a watermark in the media data depends on the size of the watermark data and the invariance of the watermark data to any data process of a host signal. There is a watermark inherent trade-off between the human perceptibility, bandwidth, and robustness (i.e., the degree to which the data are immune to be attacked or transformations that occur to the host signal through a normal usage). The more data to be superposed, the less secure the encoding process is. The less data to be superposed, the more secure the encoding process is.

[0005] The currently existing solutions for the media data protection and data copy control do not fully eliminate or significantly reduce digital media piracy. Therefore, it is essential that a new protection technology should be provided.

SUMMARY OF THE INVENTION

[0006] Accordingly, the present invention is directed to a copy protection method for digital media data that substantially

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obviates one or more problems due to limitations and disadvantages of the related art.

[0007] An object of the present invention is to provide a watermark-based copy management system for digital media copy protection that protects a media data set by embedding copy control information into the media using a watermarking technology.

[0008] Another object of the present invention is to provide a watermark-based copy management method for digital media copy protection that protects a media data set by embedding copy control information into the media using a watermarking technology.

[0009] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0010] To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a watermark-based copy management method includes receiving an original media data set that

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includes an original watermark, the original watermark including a first copy control information which is set to one of "copy freely", "copy for display only", "copy one generation", "copy never", and "no more copies"; analyzing the first copy control information to determine whether the first copy control information is set to "copy one generation"; playing the original media data set only if the first copy control information is set to "copy one generation"; embedding a player watermark into the played media data set, the player watermark including a second copy control information set to "no more copies"; and transferring the player watermark-embedded media data set to a recording device.

[0011] In another aspect of the present invention, a watermark-based copy management method includes receiving an original media data set that includes an original watermark, the original watermark including a first copy control information which is set to one of "copy freely", "copy for display only", "copy one generation", "copy never", and "no more copies"; analyzing the first copy control information to determine whether the first copy control information is set to "copy one generation"; playing the original media data set only if the first copy control information is set to "copy one generation"; embedding a player watermark into the played media data set, the player watermark including a second copy control information set

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to "copy for display only"; and transferring the player watermark-embedded media data set to a displaying device.

[0012] In another aspect of the present invention, a watermark-based copy management system includes a copy control information analyzer analyzing a first copy control information included in an original watermark embedded into an original media data set, the first copy control information being set to one of "copy freely", "copy for display only", "copy one generation", "copy never", and "no more copies"; a playing element playing the original media data set only if the first copy control information is set to "copy one generation"; a watermark generator embedding a player watermark into the played data set, the player watermark including a second copy control information set to "no more copies"; and a recording device recoding the player watermark-embedded media data set.

[0013] In another aspect of the present invention, a watermark-based copy management system includes a copy control information analyzer analyzing a first copy control information included in an original watermark embedded into an original media data set, the first copy control information being set to any one of "copy freely", "copy for display only", "copy one generation", "copy never", and "no more copies"; a playing element playing the original media data set only if the first copy control information is set to "copy one generation"; a watermark

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generator embedding a player watermark into the played data set, the player watermark including a second copy control information set to "copy for display only"; and a displaying device displaying the player watermark-embedded media data set.

[0014] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings;

[0016] FIG. 1 illustrates the media copy management method and system for playing an original media data set in accordance with the present invention; and

[0017] FIG. 2 illustrates the media copy management method and system for playing a media copy in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0018]   Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0019]   In the media copy management method and system of the present invention that employ a digital watermarking technique, the copy management information of a digital media data set is represented by a watermark, which is embedded into the data set. There are two types of watermark considered in the present invention: an original watermark (W1) generated by a media or content owner (publisher) and a secondary watermark (W2) generated by a media-playing device.

[0020]   An original media data set contains an original watermark (W1), which is embedded into the media data set by a media owner. The original watermark includes the watermark type, the identification information of the media copyright owner, and Copy Control Information (CCI) of the media data set. The watermark type is for determining whether the watermark embedded in a media data set is an original watermark or a secondary watermark. The media owner's copyright identification is used to bind the media owner with the media data set. Finally, CCI is used for managing and controlling the media data copying process.

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[0021] A legal media data set must include only one original watermark (W1). Namely, when a media data set contains two or more different original watermarks, the media data set is considered to be illegal and unplayable. Similarly, if a media data set contains two or more secondary watermarks, the media data set is also considered to be illegal and unplayable. Therefore, a legal media data set should include only one secondary watermark.

[0022] In one of the existing multimedia copyright protection methods, CCI is encoded into two bits data and has one of the following values: 00 representing "copy-freely", 01 representing "reserved for future use", 10 representing "copy one generation", and 11 representing "copy never" or "no more copies".

[0023] Another existing multimedia copyright protection method employs Encryption Mode Indicator (EMI) for representing CCI. The value of the EMI bits can be one of the following values: 00 representing "copy freely", 01 representing "no more copies", 10 representing "copy one generation", and 11 representing "copy never."

[0024] As it is shown above, the existing copyright protection methods do not consider the possibility of distinguishing a media for displaying only from an original media data set or a media copy. The copy management method and system of the present invention eliminate this disadvantage by

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representing CCI with one of the following values: 00 for "copy freely", 01 for "copy for display only", 10 for "copy one generation", and 11 for "copy never" or "no more copies."

[0025] A media data set including an original or secondary watermark marked with "copy for display only" is considered to be illegal and unplayable. A media data set including an original watermark marked with "copy freely" is not subject to any copy control management. That is, the data set should be kept unchanged during its playback process. A media data set marked with "copy freely" in its secondary watermark, but not in its original watermark, is considered to be illegal and unplayable. Therefore, only a media data set marked with "copy one generation" in its original watermark is subject to a complete digital media copy management.

[0026] When an original media data set is to be played in a playing device as shown in FIG. 1, the CCI analyzer of the playing device initially analyzes the CCI of the data set. The playing device prohibits playing the media data set for any one of the above-mentioned cases. Then the player watermark generator processes the played signal and performs a watermark embedding process. If the played media signal is marked with "copy never" or "no more copies", no signal should be issued to a recorder. Otherwise, the played signal may be recorded by the recorder. The recorded media signal contains an original watermark (W1) and a

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secondary watermark (W2) with an updated CCI. The CCI updating process is performed only for a media data set marked with "copy one generation". In the CCI updating process, "copy one generation" will be substituted with "no more copies." On the other hand, when the playing device is subject to transfer the original media data set to a displaying device, "copy one generation" will be substituted with "copy for display only".

[0027]   When a media copy is to be played in a playing device as shown in FIG. 2, the CCI analyzer of the playing device initially analyzes the CCI of the media copy. The playing device prohibits playing the copy for any one of the above-mentioned cases. In addition, the playing device analyzes the second watermark (W2). If it is determined that the second watermark (W2) conflicts with the original watermark (W1) in terms of copy control, the media copy is considered to be illegal and unplayable. When the media copy is played, the played signal may only be displayed by a digital displaying device.

[0028]   The player identification of the playing device shown in FIG. 2 should be embedded into the played signal together with the CCI. This identification may contain the player vendor, model number, and unique serial number. This information is intended to help detecting the origin of the media copy and may be used for the revocation of the compromised devices or their keys.

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[0029] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the inventions. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.